Claims

What is claimed is:

1. An apparatus for depositing a transfer material onto a receiving substrate, the apparatus comprising

a source of pulsed laser energy,

a receiving substrate, and

a target substrate comprising a laser-transparent support having a back surface and a front surface, wherein the front surface has a coating that comprises a mixture of the transfer material to be deposited and a matrix material, wherein the matrix material has the property of being or becoming more volatile than the transfer material when exposed to pulsed laser energy,

means for positioning the source of pulsed laser energy in relation to the target substrate so that pulsed laser energy can be directed through the back surface of the target substrate and through the laser-transparent support to strike the coating at a defined location with sufficient energy to cause the coating to desorb from the location and be lifted from the surface of the support,

means for positioning the receiving substrate in a spaced relation to the target substrate so that the matrix material, or decomposition products thereof, in the desorbed coating can migrate

from the space between the receiving substrate and the target substrate, and so that the transfer material in the desorbed coating can be deposited at a defined location on the receiving substrate.

2. The apparatus of claim 1 wherein the transfer material is in the form of particles and wherein the coating is a colloidal or particulate suspension of the transfer material in the matrix material.

3. The apparatus of Claim 1 wherein the transfer material is in the form of particles having a grain size of between about 10 nm and about 20 μm.

4. The apparatus of Claim 1 wherein the transfer material is a mixture of particles having different grain sizes.

5. The apparatus of Claim 1 wherein the transfer material is an electronic material selected from the group consisting of metals, dielectrics, ferroelectrics, ferrites, ferrimagnets, ferromagnets, phosphors, and semiconductors.

6. The apparatus of Claim 1 wherein the transfer material is a polymer.

7. The apparatus of Claim 1 wherein the transfer material comprises metal or ceramic particles coated with organic precursors.

8. The apparatus of Claim 1 wherein the receiving substrate is a component of a sensing device and the transfer material is a sensing material selected from the group consisting of chemically selective material, biologically selective material, magnetic sensing material, optical sensing material, pressure sensing material, temperature sensing material, porosity selective material and gas flow sensing material.

9. The apparatus of Claim 1 wherein the matrix material is a material that decomposes into volatile components when exposed to pulsed laser energy.

10. The apparatus of Claim 9 wherein the matrix material is an addition polymer.

11. The apparatus of Claim 9 wherein the matrix material is selected from the group consisting of poly(alkenes), poly(acrylics), poly(methacrylics), poly(vinyls), poly(vinylketones), poly(styrenes), poly(oxides) and polyethers.

12. The apparatus of Claim 9 wherein the matrix material is selected from the group consisting of polyacrylic acid -butyl ester, nitrocellulose, poly(methacrylic acid)-methyl ester (PMMA), poly(methacrylic acid)-n butyl ester (PBMA), poly(methacrylic acid)-t butyl ester (PtBMA), polytetrafluoroethylene (PTFE), polyperfluoropropylene, poly N-vinyl carbazole, poly(methyl

isopropenyl ketone), poly alphamethyl styrene, polyacrylic acid, alpha phenyl-, methyl ester, polyvinylacetate, polyvinylacetate/zincbromide , poly(oxymethylene), phenol-formaldehyde positive photoresist resins and photobleachable aromatic dyes.

13. The apparatus of Claim 1 wherein the matrix material is selected from the group consisting of water, aryl solvents, arene solvents, halogenated organic solvents, hydrocarbons, ketones, esters, ethers, carboxylic acids, phenols and phosphoric acid.

14. The apparatus of Claim 1 further including means for moving the source of pulsed laser energy and the target substrate with respect to each other so that after the coating desorbs at one location on the target substrate, the pulsed laser energy can be directed to another location on the target substrate where the coating has not yet desorbed, and

means for moving the source of pulsed laser energy and the receiving substrate with respect to each other so that the transfer material can be deposited in a pattern.

15. The apparatus of Claim 1 wherein the apparatus further includes a mask interposed between the source of laser energy and the target substrate.

16. The apparatus of Claim 1 wherein the coating on the front surface of the target substrate has been formed by a process of combining the transfer material and the matrix material to form a

mixture and applying the mixture to the front surface of the target substrate by a coating method selected from the group consisting of spin coating, ink jet deposition, jet vapor deposition, spin spray coating, aerosol spray deposition, electrophoretic deposition, pulsed laser deposition, matrix assisted pulsed laser evaporation, thermal evaporation, sol gel deposition, chemical vapor deposition, sedimentation and screen printing.

17. The apparatus of Claim 1 wherein the coating on the front surface of the target substrate has a thickness of between about .1 μm and about 100 μm.

18. The apparatus of Claim 1 wherein the coating on the front surface of the target substrate has a thickness of between about 1 μm and about 20 μm.

19. The apparatus of Claim 1, further including means to position the source of pulsed laser energy with respect to the receiving substrate so that the pulsed laser energy can be directed to strike the receiving substrate whereby the receiving substrate can be pretreated or whereby a transfer material deposited on the substrate can be annealed or etched.

20. A method for depositing a transfer material onto a receiving substrate, the method comprising the steps of

providing a source of pulsed laser energy,

providing a receiving substrate

providing a target substrate comprising a laser-transparent support having a back surface and a front surface, wherein the front surface has a coating that comprises a mixture of the transfer material and a matrix material, wherein the matrix material has the property of being or becoming more volatile than the transfer material when exposed to pulsed laser energy,

positioning the source of pulsed laser energy in relation to the target substrate and exposing the target substrate to pulsed laser energy so that the pulsed laser energy is directed through the back surface of the target substrate and through the laser-transparent support to strike the coating at a defined location with sufficient energy to volatilize the matrix material at the location, causing the coating to desorb from the location and be lifted from the surface of the support,

positioning the receiving substrate in a spaced relation to the target substrate so that the transfer material in the desorbed coating is deposited at defined location on the receiving substrate and so that the matrix material, or decomposition products thereof, in the desorbed coating can migrate from the space between the receiving substrate and the target substrate.

21. The method of Claim 20 wherein the transfer material is in the form of particles and wherein the coating is a colloidal or particulate suspension of the transfer material in the matrix material.

22. The method of Claim 20 wherein the steps of the method are carried out under ambient

conditions.

23. The method of Claim 20 wherein the transfer material is in the form of particles having a grain size of between about 10 nm and about 20 μm.

24. The method of Claim 20 wherein the transfer material is a mixture of particles having different grain sizes.

25. The method of Claim 20 wherein the transfer material comprises metal or ceramic particles coated with organic precursors.

26. The method of Claim 20 wherein the matrix material is a material that decomposes into volatile components when exposed to pulsed laser energy.

27. The method of Claim 26 wherein the matrix material is an addition polymer.

28. The method of Claim 26 wherein the matrix material is selected from the group consisting of poly(alkenes), poly(acrylics), poly(methacrylics), poly(vinyls), poly(vinylketones), poly(styrenes), poly(oxides) and polyethers.

29. The method of Claim 26 wherein the matrix material is selected from the group consisting of polyacrylic acid –butyl ester, nitrocellulose, poly(methacrylic acid)-methyl ester (PMMA), poly(methacrylic acid)-n butyl ester (PBMA), poly(methacrylic acid)-t butyl ester (PtBMA), polytetrafluoroethylene (PTFE), polyperfluoropropylene, poly N-vinyl carbazole, poly(methyl isopropenyl ketone), poly alphamethyl styrene, polyacrylic acid, alpha phenyl-, methyl ester, polyvinylacetate, polyvinylacetate/zincbromide , poly(oxymethylene), phenol-formaldehyde positive photoresist resins and photobleachable aromatic dyes.

30. The method of Claim 20 wherein the coating on the front surface of the target substrate has been formed by a process of combining the transfer material and the matrix material to form a mixture and applying the mixture to the front surface of the target substrate by a coating method selected from the group consisting of spin coating, ink jet deposition, jet vapor deposition, spin spray coating, aerosol spray deposition, electrophoretic deposition, pulsed laser deposition, matrix assisted pulsed laser evaporation, thermal evaporation, sol gel deposition, chemical vapor deposition, sedimentation and screen printing.

31. The method of Claim 20 wherein the coating on the front surface of the target substrate has a thickness of between about .1 μm and about 100 μm.

32. The method of Claim 20 wherein the coating on the front surface of the target substrate has a

thickness of between about 1 μm and about 20 μm.

33. The method of Claim 20 wherein the matrix material is selected from the group consisting of water, aryl solvents, arene solvents, halogenated organic solvents, hydrocarbons, ketones, esters, ethers, carboxylic acids, phenols and phosphoric acid.

34. The method of Claim 20, further including the steps of moving the source of pulsed laser energy and the target substrate with respect to each other so that after the coating desorbs at one location on the target substrate, the source of pulsed laser energy is directed to another location on the target substrate where the coating has not yet desorbed, and

moving the source of pulsed laser energy and the receiving substrate with respect to each other so that the transfer material is deposited in a pattern.

35.The method of claim 20 wherein the receiving substrate is a component of an electronic device and the transfer material is an electronic material selected from the group consisting of metals, dielectrics, ferroelectrics, ferrites, ferrimagnets, ferromagnets, phosphors and semiconductors.

36. The method of claim 20 wherein the receiving substrate is a component of a sensing device and the transfer material is a sensing material selected from the group consisting of chemically

selective material, biologically selective material, magnetic sensing material, optical sensing material, pressure sensing material, temperature sensing material, and gas flow sensing material.

37. The method of claim 20 including the further step of positioning the source of pulsed laser energy with respect to the receiving substrate so that the pulsed laser energy can be directed to strike the receiving substrate whereby the receiving substrate can be pretreated or whereby a transfer material deposited on the substrate can be annealed or etched.